

Links Between Soil Health and Biodiversity

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PES Working Group



The University of Vermont

Reminder of legislative charge

[Act 83 of 2019](#) ...The purpose of this Working Group (PES Working Group) is to recommend financial incentives designed to encourage farmers in Vermont to implement agricultural practices **that improve soil health, enhance crop resilience, increase carbon storage and stormwater storage capacity, and reduce agricultural runoff to waters.**



Why biodiversity?

“Biodiversity is an important regulator of agro-ecosystem functions.” (UN FAO)

Biodiversity is a supporting service.

Prompts for PES WG considerations:

- Identify soil health practices to **SUPPORT** and **ENHANCE** biodiversity
- Build into VT PES additional payments for biodiversity

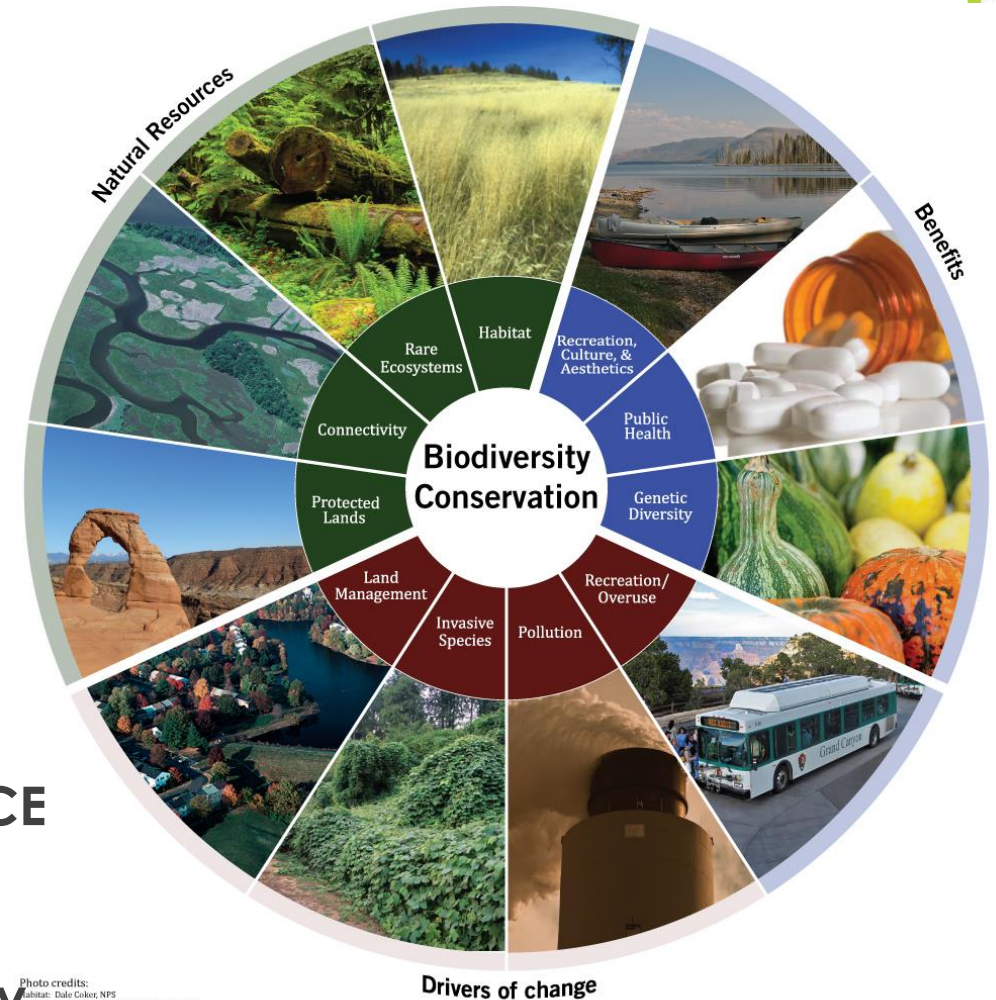


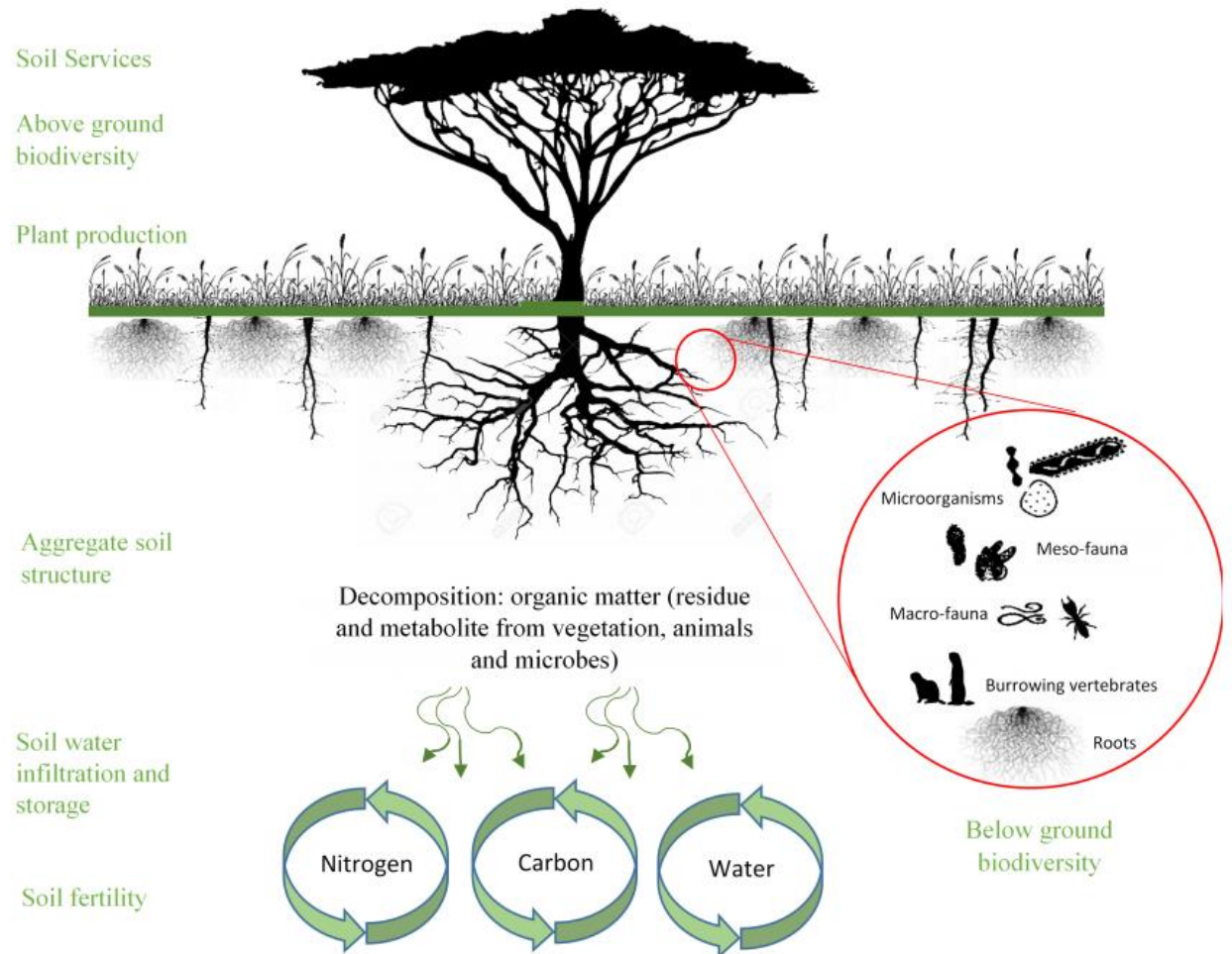
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Pollution: Eric Vance, EPA
Recreation/Overuse: Michael Quinn, NPS
Genetic diversity: Eric Vance, EPA
Public health: Amanda Mills, CDC
Recreation, culture, & aesthetics: Jim Peaco, NPS

This EnviroAtlas eco-wheel was created by Jessica Jahre, EPA contractor

Supporting a whole farm ecosystem with soil health practices

Outline:

1. How in-field practices can enhance biodiversity.
 - *tillage, mowing, crop diversity, cover crops, chemicals.*
2. Importance of field edge management for biodiversity.
3. **For later conversation:** Why forests, wetlands, and undisturbed habitat are critical to whole farm ecosystem.



Support biodiversity with reduced in-field disturbance

Possible PES metrics:

Soil aggregate stability

Days in living cover

and timing of mowings

% surface residue

Annual changes in SOM

Species inventory

- Reduce tillage
- Hayfields: adjust mow timing
- Pastures: allow regrowth for habitat





Example: no-till planting into
winter rye



Example: 70% of wild bees nest in the soil



Image credit: Salvador Vitanza, PhD.
Texas A&M AgriLife Extension.

Squash bee



Graphics credit: Penn State University,
Biology & Pollination Services of the
Squash Bee, 2021.

6"-9" in depth

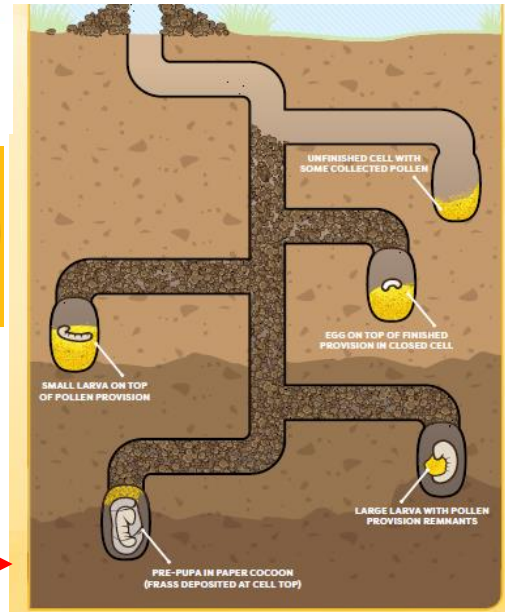


Image credit: Lopez-Urbe Lab at Penn State

Slide credit: Laura Johnson, UVM Extension

Example: grassland bird habitat



Adjust mow times for nesting
Leave strips in field
Mow from center outwards to flush wildlife
Leave grass taller at end of season



Enhance biodiversity with cropping diversity

Possible PES metrics:

- *Number of crop rotations*
- *Number of species*
- *Interseeding*

- Supports soil life
- Rooting diversity holds soil in place
- Pollinator and beneficial habitat
- Genetic diversity for resiliency



Example: interseeding and strip cropping

Annual ryegrass between cash crops



White clover between production beds left to overwinter



Example: cover crop mixes

Buckwheat, crimson clover/ Sudangrass



Sunflower, sorghum sudan grass, oat mix



Example: perennial inter-seeded alleyways with flowering forage

Clovers

Frost seed (non-sandy soil)

No-till drill (all soils)



Attract generalist bees, like honey, bumble, and sweat bees

Enhance biodiversity with flowering crops

Possible PES metrics:

- *Additional payment for letting a cover crop flower*
- *Acreage in bloom*

- Hosts pollinators and beneficials
- Let hay fields bloom



Example: annual flowering cover crop strips

Sweet
alyssum



Mustard



Buckwheat

Attract generalist bees, like honey, bumble, and sweat bees

Sunflowers,
Bear Roots
Farm



Image source: <https://cfgrower.com/floral-strips-in-cucumber-fields/>



Example: leaving winter food for birds



Japanese millet with seed heads

Support biodiversity with reduced chemical inputs

Possible PES metrics:

IPM implementation

Reduced spray events

Water or crop residue tests

Active pollinator counts

Soil microbes (Ecoplates)

- Healthy pollinator and beneficial populations
- Many effective biological substitutes exist
- Supports soil biota



Example: avoid applying pesticides directly or allowing them to drift onto flowering plants visited by bees

Carpenter bees (below, left) lay eggs on a ball of pollen and nectar (right). If pollen and nectar are contaminated with residues, larvae may have lethal or sublethal effects.*



*Image and text credit: Xerces Society, Farming For Bees publication

Example: use windbreaks to reduce drift

- Windbreaks like conifers that are unattractive to pollinators can prevent drift



**PROTECT BEES
READ PESTICIDE LABELS**

*Images credit: Xerces Society, Farming For Bees publication

Example: high glucosinolate mustard bio-fumigation



Enhance biodiversity with reduced disturbance *around* fields

Possible PES metrics:

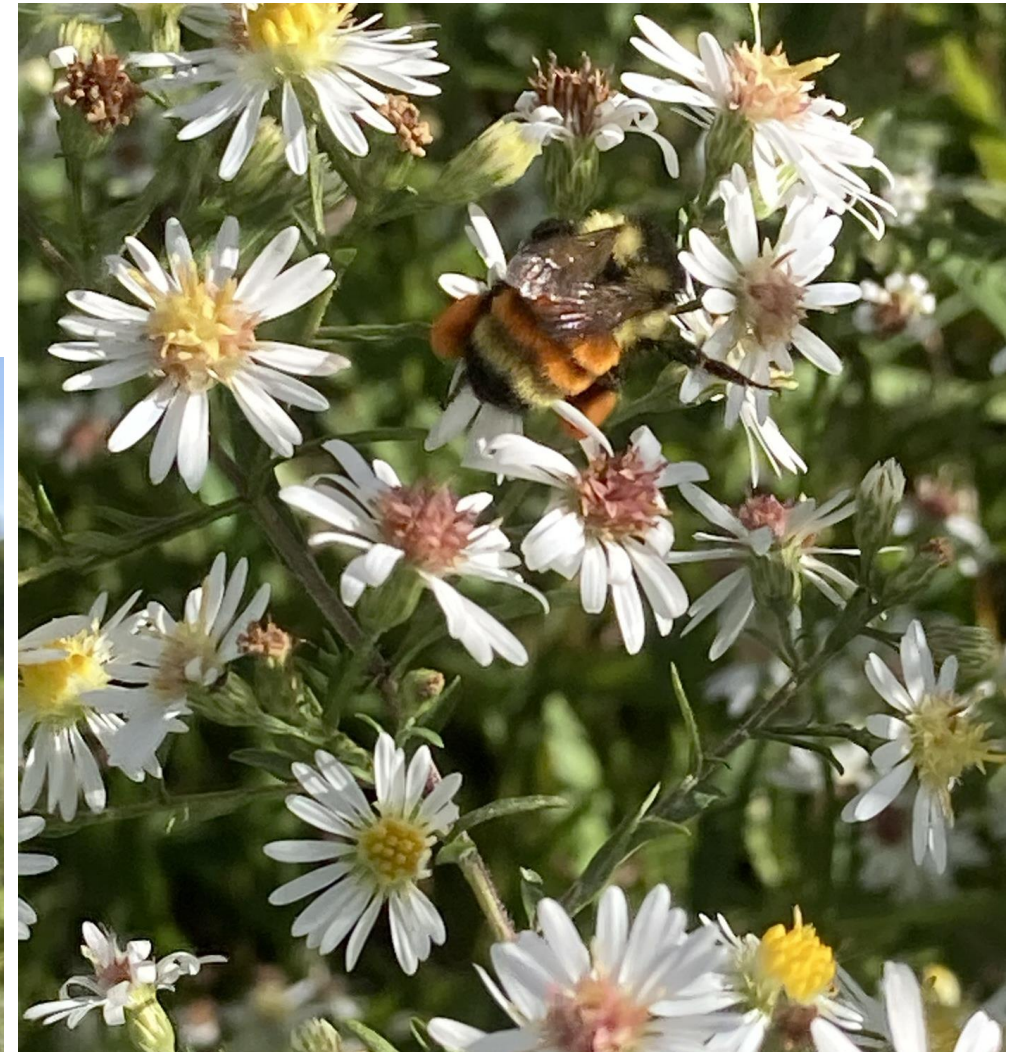
- *Height of plants at end season*
- *Species inventory*
- *Number and timing of mows*

- Confine disturbance to well managed field areas; keep edges wild
- Mow less
- Mow later
- Raise the blade
- Strong and diverse root structures hold soil



Example: perennial meadows and field edges

- “No Mow May”
- Leave wildflowers standing until hard frost
- Rotationally mow each fall, leaving 2/3rds standing



Attract generalist bees, like honey, bumble, sweat bees, and many others that have co-evolved with wildflowers!

Example: cavity nesting sites for bumble bees



Ground nesting sites for squash, squash cuckoo, and sweat bees



Questions/ discussion

What metrics or proxies could be used to measure biodiversity?

Unintended consequences of these metrics/ payments?

How do existing PES programs foster biodiversity?

Opportunity for farmers to design a plan for farm-specific conditions; self-monitor progress.

* * * * *

Research needs

Identify optimal sizes of buffer areas/ field edges/ unmowed areas for critical habitat.

Identify critical mowing times and height for habitat.

Thank you!

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